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Shrimp Waste - A Valuable Protein Source for Aqua Feed

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SUMMARY

The edible part of crustaceans such as shrimps, crabs, lobsters represents only 20-25%, and the remaining are discarded as wastes. Approximately 70% of total shrimp landings end up as waste, so there is a tremendous tonnage of shrimp waste produced globally. These wastes are rich in protein and chitin, making them suitable as a protein source in animal feed. Shrimp waste is available in large quantities with low cost and can be converted into a meal or fermented hydrolysate product to replace fish meal and soya bean meal in aquafeed, which in turns reduces the cost of feed in aquaculture.

INTRODUCTION

Fishery processing activities produce many by-products, and among them, some have been used as a feed ingredient in animal feed. The shrimp by products such as head, appendages, exoskeleton, and hull waste from the fishing boats or shrimp processing plants during the shrimp fishing season generates a large amount of waste. Shrimp heads alone contribute around 35-45% of the total shrimp production. Shrimp by-products, being a feed ingredient, is also used as a flavour enhancer. Sometimes, they are incorporated up to 30% in the diet of shrimps due to their excellent amino acid, essential fatty acid profile, and their carotenoid pigment content (Meyers, 1986).

Shrimp waste

Shrimp meal

The addition of crustacean meals such as shrimp meal or crab meal in the diet of fishes or shrimps was very effective in improving the growth and colour of fish fillets (Cruz-Suarez et al., 1993). Shrimp waste is also rich in lysine and chitin and, therefore, have the potential to be used as a promising animal protein source in the diet of fishes and shrimps (Fox et al., 1994).

The nutritional profile of shrimp meal:

According to Fox at al., (1994), the proximate composition of the oven-dried shrimp head meal has a crude protein of 46%, crude lipid 9.8 %, moisture 4.4 %, ash 26.1 %, and chitin 14.3 %. In the solar-dried shrimp head meal, the nutritional composition is crude protein 44.4%, lipid 8.4 %, moisture 5.8 %, ash 27.8 %, chitin 15 %. The shrimp head silage, which is prepared from the raw meat collected from the meat and bone separator, and then by mixing it with 3% formic acid for three weeks, contains crude protein 51.2%, crude lipid 11.4%, moisture 12.7%, ash- 19.8%, and chitin 8.8%. Cooked, pressed shrimp head meal contains high nutritional value of crude protein 42.2%, crude lipid 6.2%, moisture 8%, ash 29.7%, and chitin 17.6%. Shrimp head silage meal contains crude protein 58.96%, lipid 3.61%, moisture 10.58%, ash 21.87% and fibre- 3.61% (Nwanna et al., 2003). Fagbenro and Bello-Olusoji (1997) stated that the nutritional composition of the solar-dried shrimp head meal contains crude protein- 51.3, lipid- 9.2, ash- 23.9, chitin- 12.6 as g/100 g dry matter. And the blended fermented shrimp head silage and hydrolyzed feather meal contain high crude protein- 65.6, crude lipid- 8.3, ash- 8.7 and chitin- 6.8 as g/100 g dry matter. Also, the blended fermented shrimp head silage and poultry by-product meal contain a high amount of crude protein 52.1 %, lipid 14.8 %, ash 15.2 % and chitin 7.5 %.

Shrimp meal as a feed for freshwater fishes:

El- Sayed (1998) studied the effects of dietary fish meal substitution with the animal protein sources in *O. niloticus* and stated that the fishes fed with Shrimp meal did not significantly differ from the control. However, feed conversion ratio and protein efficiency ratios were greatly retarded. And crustacean waste product from the fishing and fish processing industry can be used successfully to partially replace fish meal in the diet of rainbow trout for better digestibility and growth, with suitable amino acid supplementation (Ozogul, 2000). According to Plascencia- Jatomea et al., (2002), shrimp protein hydrolysate, one of the promising protein feedstuffs, can be used as a protein source in the diet of the Nile tilapia *(O. niloticus)* as much as 15% for better growth and feed intake. In recirculating aquaculture systems, the impact of replacing fish meal with 0, 5, 10, 20, 30 and 40% of fermented shrimp head waste meal (FSHM) in the diet of African catfish *Clarias gariepinus* showed that 40% inclusion of FSHM in the diet resulted in high mean weight gain and specific growth rate (SGR) compared to other lower levels (Nwanna, 2003). Shrimp head silage powder contains 40% of crude protein and suitable substitute for fish flour in the diet of tilapia (*Oreochromis niloticus*) up to 100%, without affecting the growth and flesh quality of the animal (Cavalheiro et al., 2007). Further, shrimp head hydrolysate can be included as much as 6% in the diet of Nile tilapia without causing any adverse effects on animal (Leal *et al*., 2010). The effect of shrimp shell meal as a 0, 33, 50, 67 and 100% replacement for soya bean meal in the diet of hybrid tilapia (*O. niloticus x O. aureus*) fry reared under brackish water showed that 100% shrimp shell meal in the diet exhibited poor specific growth rate (SGR), and their replacement within the range of 33 – 67% in the diet provides better food conversion ratio (FCR) (Fall *et al*., 2012). Raja Nandini *et al*., (2014) conducted a study to determine the effects of total replacement of fish meal with shrimp waste meal in the diet of koi carp and observed that inclusion of shrimp waste meal at 25% and 50% in the diet of koi carp showed highest body protein content. Therefore, shrimp waste meal can be used to replace fish meal up to a maximum of 50% in the diet of koi carp for better growth and pigmentation. The incorporation of the shrimp meal as a primary animal protein source in the diet of catla (*Catla catla*) fry resulted in higher final weight and final length, % weight gain, specific growth rate (SGR) and protein efficiency ratio (PER) (Kamble *et al*., 2017). Waste meals of *Feneropenaeus indicus* (Indian white shrimp) can be utilized as an alternative feed ingredient to fish meal to reduce production costs in culture of common carp *C. carpio*. Further, suitable digestive enzyme activities and biochemical muscle compositions are also obtained against other diets such as *R. kanagurta* and *S. barracuda* waste meal and control diet (Muttharasi *et al*., 2019). A similar study was conducted by Fall *et al*., (2020) to determine the effect of crustacean meal (Callianassa-a genus of mud shrimp) as a replacement for fish meal in the diet of mixed-sex Nile tilapia (*Oreochromis niloticus*) fry, and revealed that 50% replacement with crustacean meal provided better food conversion ratio (FCR). Still, the final weight, absolute mean weight gain, relative mean weight gain, and specific growth rate were not significantly different from the control. And 25% replacement of fish meal in diet did not cause any adverse effect on the growth performances and feed efficiency of Nile tilapia. Al-Jader and Al-Khshali (2021) studied the effects of using shrimp meal at different levels viz., 0, 16, 32 and 48% of replacement for the protein concentration in the diet of common carp (*Cyprinus carpio*). They observed that shrimp meal at 32% in the diet of common carp provided superior total weight gain rate, daily growth rate, and feed conversion rates. In addition, the essential and non-essential amino acids also increased and that improved the growth parameters of common carp.

Shrimp meal as a feed for marine fishes:

Cejas et al., (2003) evaluated the fatty acid composition and skin pigmentation in the red porgy (*Pagrus pagrus*) alevins, fed with the commercial pellet diet incorporated with 12% shrimp *Pleisonika sp.* The red porgy effectively assimilated the natural carotenoids supplied via the experimental diet, and fishes attained skin colouration similar to that of the wild fish.

Shrimp meal as a feed for shell fishes:

Cruz-Suarez et al., (1993) evaluated the effects of the shrimp by-product meal in the shrimp feeds as a 3%, 6% and 18% replacement for the fish meal and soya bean meal in the control diet. Further from the study results, it could be concluded that shrimp by-product meal can be included up to 18% in the diet of *P. vannamei* for best growth responses. Diets containing 31% solar-dried or oven-dried or MBDD shrimp head meals show better performance in terms of final individual weight, feed conversion ratio compared with the control 54% fish meal-based diet in the juveniles of *Penaeus monodon*. And the inclusion of shrimp head meals increased the palatability and reduced the water stability against the fish meal-based diet (Fox et al., 1994).

CONCLUSION

Shrimp wastes are rich in protein, lipid, vitamins, minerals, mainly calcium carbonate and chitin. They are an efficient protein feed ingredient used in the aquafeed to replace fish meal and soya bean meal. Further utilization of such protein-rich wastes also reduces the environmental contamination caused by their disposals. These wastes can be efficiently converted into feedstuff for animals, reduce the cost of production, and hazard to the environment.

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